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Direct Testimony

Of

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Policy Program
Policy Division
Illinois Commerce Commission

Petition for Approval of Electric Energy Efficiency Plan

Commonwealth Edison Company

Docket No. 13-0495

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I. Witness Qualifications

Q. Please state your name, job title and business address.

A. My name is David Brightwell. I am an Economic Analyst in the Policy Program of the Policy Division of the Illinois Commerce Commission ("Commission"). My business address is 527 East Capitol Avenue, Springfield, Illinois 62701.

Q. Please describe your educational background.

A. I received a Ph.D. in economics from Texas A&M University in 2008. My major fields of study were industrial organization and labor economics, and my minor field was econometrics. I received a bachelor's degree in political science in 1992 and a master's degree in applied economics in 2002, both from Illinois State University.

Q. Please describe your work background.

A. I have been employed as an Economic Analyst with the Commission since June 2008. I have focused on energy efficiency and smart grid related issues at the Commission. From 2002-2008, I attended Texas A&M University, where I served as a teaching assistant or an instructor for various courses. From 2000-2002, I served as a graduate assistant for David Loomis at Illinois State University.

Q. Have you previously testified before the Commission?

A. Yes.

II. Testimony and Recommendations

Q. Please provide the purpose of your testimony and your recommendations in this proceeding.

A. The purpose of my testimony is to address Commonwealth Edison Company's ("ComEd") proposal for excluding free ridership rates from Net-to-Gross ("NTG") values unless spillover rates are also included. I also address deeming NTG ratio values and ComEd's Potential Study. Staff witness Jennifer Hinman provides an alternative NTG Framework (Staff Ex. 1.1). I address the incentives of a partially retrospective application of NTG ratio values which is included in Ms. Hinman's proposal. I also address ComEd's marketing of residential lighting.

III. Calculating Net-to-Gross ratios

Q. Please describe ComEd's proposal for calculating NTG ratios.

A. ComEd proposes that all program evaluations must address, in addition to free ridership, spillover from both the participant and non-participant perspectives. Without these perspectives, the evaluation is unduly reducing the net program impacts that should be realized by a program. If an evaluation does not account for spillover, then the free rider effect should also be ignored. (ComEd Ex. 1.0, 110-111.)

Q. What are free ridership and spillover?

A. A free rider is someone who uses program funds to take actions that he or she would have taken anyway, even if no program funds were offered. The significance of a free rider is that since this customer would have installed the measure anyway, there is no incremental savings to attribute to an EE program.

Spillover is more difficult to define. I would describe spillover as changes in energy efficiency and conservation practices that result from increased knowledge of energy efficiency through experience with the program and/or word of mouth or a general increase in knowledge about EE that results from the existence of the EE program.

Q. How do free ridership and spillover relate to NTG ratios and net savings?

A. A NTG ratio is one minus the free ridership rate plus the spillover rate. If the free ridership rate is estimated as 20% and spillover is estimated as 10% then the NTG ratio is 0.9 (1 - 0.2+ 0.1 = 0.9). The value of the NTG ratio indicates what percentage of gross savings is attributable to actions of the program. In this example, it indicates that 90% of gross savings occurred as a result of program activities. Net savings is calculated by multiplying gross savings by the NTG ratio. If gross savings for a program are calculated as 1,000 kWh and the NTG ratio is calculated as 0.9, then net savings equals 900 kWh (1000 X 0.9 = 900 kWh).

Q. What is your opinion of ComEd's proposed method of calculating NTG ratios?

A. There is merit in attempting to quantify both free ridership and spillover. However, the measurement and quantification of spillover is much more difficult and expensive than that of free ridership, and, as a result, spillover might not be quantified. Under ComEd's proposal, any program for which it is too costly or

difficult to measure both participant and non-participant spillover will effectively be credited with net savings equal to gross savings. Given the costs and difficulty of measuring spillover, ComEd's proposal could result in most programs measuring gross savings rather than net savings.

. I recommend that the Commission instead direct the independent evaluators to make reasonable efforts to calculate both free ridership rates and spillover rates while being mindful of: (1) the costs of such evaluations, (2) the likely magnitudes of spillover and free ridership rates within a program, and (3) the significance of the program to the overall portfolio savings.

Q. Why do you believe spillover is more difficult and costly to measure and quantify than free ridership?

A. Measuring spillover is by its definition an attempt to measure changes to behavior that took place outside of program channels because of the existence of the program. It is difficult to know what other actions or inactions a participant took as a result of their experiences with the program. It is next to impossible to know what a utility customer with whom the EE programs had no direct contact did as a result of a utility program.

At least in measuring free riders, most utility programs have information on which customers received rebates or incentives, what items were purchased and how to contact those customers for evaluation interviews/surveys. This information can be used to attempt to ascertain what motivated these customers to use the

utility program to purchase a measure or measures. This does not imply that measuring free ridership is costless or easy; rather, information exists to know where to begin the investigation.

Q. You previously stated a concern that adopting ComEd's proposal for calculating NTG ratio values would ultimately lead to counting gross savings. Why?

A. Spillover is much more difficult to quantify, particularly non-participant spillover. It is also costly. Evaluation budgets are limited to 3% of the portfolio budget. As a result of the difficulty and the cost involved, evaluators most likely cannot evaluate spillover for all programs and certainly cannot evaluate it for all programs within the first year of the upcoming plan. Accordingly, it seems under ComEd's proposal that neither spillover nor free ridership would be included in the NTG ratio values of many or all programs at the start of the next Plan and may not be measured for many programs by the completion of the next three year Planning Period. If neither spillover nor free ridership is counted, only gross savings remain.

Q. What's wrong with a shift to gross savings?

A. The current approach is to include either or both estimates of free ridership and spillover when one or both can be calculated. ComEd's proposal to include neither factor if both cannot be calculated produces a gross savings result that is likely to reflect greater overestimates of the savings attributable to the program. I

believe that applying gross savings to the determination of savings goals leads to incentives that are adverse to the interests of ratepayers and is the result of a disproportionate emphasis on the impact that spillover has on EE program savings.

Q. Please describe the disproportionate emphasis placed on the impact of spillover on EE program savings.

A. Spillover is essentially knowledge about EE that was gained as a result of program actions. I am not an attorney, but my understanding of Section 8-103 of the Public Utilities Act ("Act") is that the savings goals relate to incremental first year savings. I interpret this to mean that the spillover that requires measurement as far as meeting annual savings goals is indirect savings that resulted in the installation of measures in the same Program Year as the knowledge was gained. That is, if a customer replaced an air conditioning unit in May of a calendar year, liked the outcome after seeing savings in the summer months, and added insulation to the house in September of the same calendar year (without using a utility rebate), then this is spillover that does not affect first year savings, as September and May are not in the same Program Year.

Additionally, this is an example of participant spillover. Evaluators have attempted to quantify this type of spillover and in most cases find the impact to be small and often too small to be measurable. For non-participant spillover to affect first year savings, the person who received the air conditioner rebate would

have had to tell others, and those who received this information would have had to either have bought an air conditioner without the rebate or installed other EE devices without a rebate all within the same Program Year in which the program participant installed the air conditioner. In my experience, I cannot recall anyone ever providing me with a detailed account of an air conditioner that was installed, or adding insulation to a house or implementing any other type of EE measures. For experiences to translate to spillover that affects first-year savings, a person has to be positively influenced to install some EE measure or measures and go through channels other than the utility in the process of installing the measures. I am skeptical that such events produce a large degree of nonparticipant spillover. While spillover is likely small, many programs have evaluations that have estimated free ridership of 30% or greater. By not counting free ridership unless spillover is also measured, the Commission is being asked to approve a policy that would be assuming that first-year spillover is effectively 30% or more for these programs. Based on this, a gross savings approach is likely to lead to a much larger error in measuring savings than maintaining the current evaluation approach. That is, a combination of personal experience and the evaluations I have reviewed as part of my duties at the Commission lead me to conclude that savings from first-year spillover is minimal.

Q. Are there other factors that cause spillover?

A. Yes. One possibility is marketing of energy efficiency. By marketing the Smart Ideas program, it is possible that ComEd is creating greater general awareness of EE which cause EE investments to occur outside of program channels. However, marketing probably does not provide a sufficient spillover impact to offset the reduction in gross savings that are attributable to free ridership. It needs to be pointed out that marketing that is effective at getting ratepayers to use utility programs is not spillover. Spillover only occurs when marketing is effective at enticing ratepayers to install EE measures without a utility rebate or program. The idea of customers performing EE investments as a result of learning about EE investments from the program's marketing efforts prompts the question of why a customer who is aware of and eligible for a rebate would not use the program to receive a rebate. This tends to further suggest that it is unlikely that first-year spillover is causing substantial measurement error in net savings.

Another potential means through which spillover may occur is through non-participating trade allies promoting EE equipment. However, in my opinion, this is a gray area that can cause an over-calculation of first-year savings and lead to unnecessarily prolonging the continuation of programs. A trade ally is a contractor or vendor who registers with the EE program, receives information about the rebate process, some training on promoting EE equipment, and potentially some training on differences in the installation of EE equipment versus

standard energy-using equipment. The thought is that these non-participating trade allies use the information provided by the program to promote the sale of EE equipment but do not actively participate in the program. As a result, EE investments would be made because of the program without the programs receiving credit. Since any savings from nonparticipating trade allies is by definition savings that results from the EE program having past involvement with the non-participating trade allies, it seems that savings attributable to these contractors can either be categorized as intertemporal spillover, spillover that occurs in the present from past actions, or perhaps as market transformation. In the event that it is intertemporal spillover, there is negligible incremental *first-year* savings attributable to the program.

If non-participating trade ally activity is better classified as market transformation, then once these contractors receive the information, they are actively using the knowledge gained to promote EE equipment indefinitely. It is possible under this circumstance to prolong a program beyond its usefulness. This would occur if the savings from non-participating trade allies being applied in an evaluation is large enough to justify continuing a program that could not be justified on the basis of savings from participating trade allies alone.[1]

Q. Are there any other factors that may lead to overestimated savings?

[1] The benefits from continuing the program are overstated because the non-participating trade ally savings would have occurred even if the program was not in effect in the year being evaluated. As a result, greater benefits are being attributed to the continuance of the program than there should be.

A. Yes. The measure of incremental savings compares the difference in energy use between an energy efficient device and another device that serves as a baseline. The baseline device is in many cases the minimally efficient device permitted by an appliance standard. If one was accurately measuring incremental savings the baseline device would be the device a customer would have installed if the more efficient device was not installed. If a ratepayer would have installed the minimally efficient device, the baseline is correct. If the ratepayer would have installed a device that was more efficient than the assumed baseline but less efficient than the device for which an incentive is received, the baseline is incorrect and gross savings are overestimated.

Two examples where this phenomenon is likely happening are furnaces and lighting. The current baseline for furnaces is an 80% Annual Fuel Utilization Efficiency ("AFUE") furnace. A 90% AFUE furnace standard was expected to become effective in 2013.[2] I understand that part of the motivation to increase the standard to 90% was a belief that the 80% standard was lower than the efficiency level most customers were choosing for replacements of old furnaces or for furnaces in new facilities.[3] To the extent customers are choosing furnaces with greater than 80% AFUE, the baseline for furnaces overestimates the actual incremental savings.

[2] The standard was suspended indefinitely to receive further comment and to do more analysis.

[3] The minimum efficiency for a furnace is 78% AFUE. The Illinois TRM uses 80% AFUE as the baseline.

Residential lighting standards began changing in January 2012 when requirements from the Energy Independence and Security Act of 2007 (EISA") became effective. In January 2012, EISA required lumen outputs that were previously achieved with 100 Watt incandescent bulbs to be achieved with 72 Watts or fewer. This changed the assumed baseline from 100 Watts to 72 Watts. The incremental savings from lighting is now the difference between an efficient bulb of equivalent lumens and a 72 Watt bulb. This very well may be an incorrect baseline as lighting manufactures are not producing 72 Watt incandescent bulbs with prices close to the 100 Watt incandescent bulbs. Instead, 72 Watt bulbs tend to be halogen lights that cost as much or more than CFLs. It could be argued that CFLs should be the baseline.[4] If a CFL is in fact the correct baseline, every CFL sold generates no incremental savings. However, under the current baseline, positive gross savings are assumed.

ComEd's proposal to only include free rider estimates when spillover is also estimated neglects to consider that net savings is the product of multiplying gross savings by the NTG ratio. If gross savings are overestimated and a NTG ratio that excludes spillover is underestimated, it cannot be concluded that net savings are underestimated. ComEd's proposal presumes that the inherent bias works against the Company and is of such magnitude that a better alternative is

[4] ComEd witness Michael Brandt acknowledges that CFLs may become the new baseline (ComEd Ex. 2.0, 9.)

to ignore any estimate of free ridership when it is too costly or difficult to estimate spillover.

Q. Why do gross savings lead to adverse incentives harmful to ratepayers?

A. ComEd is required by statute to meet savings targets. Penalties apply if the savings goals are not met.[5] Achieving gross savings is not in the best interest of ratepayers because ratepayers pay for the EE programs. Ratepayers only gain benefits as a result of these payments from net savings, not from gross savings. Gross savings are much easier to achieve than net savings. By definition, programs with high rates of free ridership have a high level of savings that can be achieved even without any utility intervention. With a gross savings goal, a utility has an incentive to devote resources to these types of programs. First, to the extent savings are the result of free riders, utility revenues and profits are not eroded by energy efficiency. Second, it takes less effort to encourage customers to take the rebate if most of those customers were going to do the project anyway. This is essentially the path of least resistance.

Unfortunately, free ridership provides little or no benefit to ratepayers as a group. The nonparticipating ratepayers who pay for the project see their money given to other ratepayers who are taking actions free riders would take without the utility intervention. There are no incremental benefits associated with free

[5] *See* 220 ILCS 5/8-103(i).

riders, but there are costs associated with administration of EE programs. Programs designed to cater to free riders provide little benefit, redistribute wealth and take real resources away from society through program administration. Funding programs or measures for which the market has been transformed by any cause including past utility actions into a marketplace now making EE investment the norm results in reduced funding for programs and measures that provide incremental energy savings that are required to reduce direct and indirect costs to ratepayers, and satisfy the underlying purpose of the statutory targets. The EE programs are intended to encourage ratepayers to adopt EE measures which they would not adopt without the existence of the program. Using a gross savings approach undermines the intent and purpose of the EE statutes.

Q. Are there any other problems with utility programs providing benefits to free riders?

A. Yes. EE programs create a redistribution of wealth. That is, each rebate takes money from non-participating customers and redistributes it to participating customers. There is a higher likelihood that this redistribution takes place by taking money from lower and moderate income customers and redistributing it toward higher income customers.

Q. What is the basis for this greater likelihood?

A. The assumption made in DCEO's low income programs (Docket No. 13-0499, DCEO Ex. 1.0, 38) is that free ridership rates are very low because the

customers in the low income segment do not have the income necessary to make EE investments absent the rebates. It is reasonable to assume that a customer's willingness and ability to make the investments absent the program increase as his/her income or wealth increase. Thus, free ridership is likely to grow with participant income.

IV. Net-to-Gross Framework

Q. Please explain your understanding of the reasons for adoption of the previous NTG framework.

A. Evaluations tend to be completed after the Program Year is completed. As a result, the information is not available until October or November of the next Program Year, sometimes later than that. For example, Electric Program Year 1 was completed on May 31, 2009. The evaluators collected data, reviewed it, made verifications of installations, etc., then made preliminary reports available. The utilities and parties in the Stakeholder Advisory Group commented on the reports, which went through revisions before final versions were produced in or after November 2009. Thus, half of Program Year 2 was complete by the time that Program Year 1 evaluations were completed. Retrospective evaluation was problematic from a utility perspective because not only was PY1 complete but most of PY2 was also complete by the time the utilities knew what the PY1 savings would be. The NTG ratio values were one of the largest sources for this

uncertainty. As a result, a NTG framework was proposed in the 2010 EE hearings. As I understand matters, this framework was intended to provide greater certainty to utilities by recognizing that in many cases, the market for EE products doesn't change much. The result being that prospective NTG ratio values would be used to count savings in most cases

Q. How did the original NTG Framework resolve the problems of delayed reporting of NTG values?

A. The original NTG framework approved by the Commission in 2010 largely allowed for prospective determination of NTG values. Some of the areas where there was to be retrospective application of NTG values are when the program was new and lacking previous evaluation or when programs experienced significant changes in program delivery or market conditions.

Q. Are there any potential concerns with applying NTG ratio values on a prospective basis?

A. Yes. Since evaluation reports are not completed until about November of the following Program Year, there is a two-year lag between the time the NTG values go into effect for prospective application. That is, the PY1 evaluations were not complete until midway through PY2 and would not apply for prospective application until PY3. As a result, prospective application estimates savings based on conditions that are about two years old at the time the NTG ratio values are being

applied. When the market is stable, this may be a reasonable approach. When the market is changing, a NTG ratio value that is two years out of date by the time it is applied is problematic. It is problematic because it provides too much certainty to the affected utility to the detriment of its ratepayers in times of uncertain market conditions.

Q. Please provide an example of providing too much certainty to the utility to the detriment of its ratepayers.

A. One area of disagreement about whether there is significant market change is in the residential lighting market. There are disputes about whether the EISA provisions eliminating the manufacture of certain incandescent light bulbs along with a general acceptance of compact fluorescent lights ("CFLs") by consumers created a significant market change. The evaluated NTG ratio for PY5 is 0.55 for standard CFL bulbs while using a prospective NTG ratio from PY3 results in a NTG ratio of 0.71 being applied. (ComEd EPY5 Evaluation Report, 5.) By using the 0.71 NTG ratio value from PY3, ComEd is essentially claiming 22.5% greater[6] "paper savings" from residential lighting than the evaluations indicate actually occurred. This is beneficial to ComEd but its ratepayers may be better off if some of this money was spent elsewhere.

[6] (.55-.71)/.71 = .225 or 22.5%.

Q. Please describe ComEd's NTG proposal.

A. ComEd witness Mr. Michael Brandt proposes:

- For existing programs, when a ComEd evaluation of a program has identified an estimated NTG ratio, that ratio will be used prospectively until a new ComEd evaluation estimates a new NTG ratio. The prevailing NTG ratio provided by the EM&V contractor by March 1 of any Plan year is the NTG ratio value to be applied to the next Plan year beginning June 1.

- For new programs, planning NTG ratio values that have been provided by the EM&V contractors by March 1 of any Plan year, will be applied prospectively to the next Plan year beginning June 1. These values will be used until a ComEd evaluation estimates a revised NTG ratio. If the revised NTG ratio is provided by the EM&V contractor by March 1, then the ratio will be applied to the next Plan year beginning June 1. Thereafter, NTG ratios shall be revised according to the framework for existing program described above. (ComEd Ex. 2.0, 64-65.)

Q. Do you support Mr. Brandt's proposal to deem NTG values with the most recent evaluation result available on March 1 of the year preceding the next Program Year?

A. No. In most circumstances, I believe that prospective application of NTG ratio values is reasonable. The circumstances in which I do not are addressed in the alternative NTG Framework proposed by Staff witness Jennifer Hinman. (Staff Ex. 1.1) In particular, Mr. Brandt's proposal resolves the problem of "significant market change" by ignoring it. I do not believe that is appropriate. Additionally, Mr. Brandt's approach of relying on planning NTG values for new programs is also problematic as there may be little justification for these planning values.

Instead, Ms. Hinman's proposal includes a provision that would provide more certainty to utilities than a retrospective application while acknowledging that new programs and programs undergoing changes in market conditions are inherently risky to both program administrators and to the ratepayers who are paying for the programs. (Staff Ex. 1.1)

Q. How does Ms. Hinman's proposal address the concern about using evaluated NTG ratios that are two years old?

A. In times when a consensus cannot be reached regarding whether there is significant market change, instead of applying a retrospective NTG ratio value in PYt+1, the average of evaluations conducted in PYt-1 and PYt would be used. For example, if parties cannot reach a consensus on a NTG ratio value for the upcoming PY 7 that begins on June 1, 2014, then the average of the evaluations for the PY5 and PY6 evaluations would be applied.

Q. How does Ms. Hinman's proposal affect incentives for program management?

A. The proposal provides more certainty than the current approach of a fully retrospective evaluation because the evaluation result from PYt-1 should be known at the time that planning for PYt+1 takes place. In some cases, the estimated NTG ratio for PYt may be available by March 1 of the current Program Year as well.

However, it still provides some uncertainty and risk because the result of PYt may not be known by the time that the utility has to make plans for PYt+1.

Additionally, since there is a degree of uncertainty, the utility has an incentive to agree to a consensus deemed value reflective of the value likely to exist in the Plan Year or to move funds away from a risky proposition and towards less risky propositions. This provides benefits to ratepayers because the utility now has an incentive to manage risky programs rather than to divert the risk to ratepayers.

V. Potential Study

Q. Please comment on ComEd's Potential Study.

A. The potential study presented by ComEd measures what it refers to as "economic potential." Economic potential, as used in the Potential Study, measures the amount of savings possible from using the most technologically efficient replacement equipment that has positive net benefits compared to a base level of equipment (ComEd Ex. 1.0 Appendix D, i.) My concern is that this definition of economic potential is equivalent to asking "What is the potential energy savings from replacing current equipment with the most energy efficient piece of equipment that provides net benefits to customers?" It does not answer the question "What is the potential energy savings if current equipment is replaced with the energy efficient equipment that maximizes net benefits to ratepayers?" The second question addresses the issue of which equipment efficiency would maximize the

welfare of ratepayers by providing the economically efficient level of energy efficiency. The answer to this question is what economists typically consider to be economic efficiency.

Q. How do you propose to measure economically efficient potential?

A. The concept economists use to measure economic efficiency is called marginal analysis. In the context of the potential studies, one applies marginal analysis by ranking equipment in degree of energy efficiency relative to the current stock of equipment from the lowest to the highest. Once the ranking is complete, one examines the additional benefits and additional costs of moving from the current equipment to the piece of equipment that is ranked slightly higher. This examination would be completed again comparing the additional costs and benefits from the next highest-ranked piece of equipment to the previously examined more efficient equipment. This process is repeated until the additional benefits of the next highest-ranked piece of equipment are less than the additional costs of that piece of equipment. Economic efficiency is determined by choosing the last piece of equipment that achieves marginal benefits greater than marginal costs.

Q. Please provide an example.

A. Table 1[7] provided below illustrates the point. In the table, air source heat pumps ("ASHP") are being analyzed. The information is from Ameren's analysis but the concept applies equally to any measure from any EE Program. The baseline ASHP is compared to three tiers of energy efficient and cost effective ASHPs. Since the first comparison is between the baseline technology and a 14.5-14.9 SEER rated ASHP, the incremental benefits above the baseline unit and the marginal benefits are the same. Likewise, the marginal costs are equivalent to the incremental costs above the baseline as well. The 14.5-14.9 SEER ASHPs offer marginal benefits and marginal costs of $669 and $473, respectively. That is, ratepayers are better off moving from the baseline to the 14.5-14.9 range. The 14.5-14.9 range adds $669 in additional benefits but only costs $473 more. The next step is to determine if a 15.0-15.9 SEER ASHP offers more benefits than costs when compared to a 14.5-14.9 SEER ASHP. The table indicates that the benefits from the 15.0-15.9 SEER level are $930 compared to $669 for the 14.0-14.9 SEER level. The marginal benefit is $261 ($930-$669). The marginal cost is $156 ($629-$473). Once again, the additional benefits exceed the additional costs so ratepayer welfare improves when ratepayers increase the efficiency from 14.5-14.9 to 15.0-15.9 SEER units. However, moving from the 15.0-15.9 SEER range to the 16.0+ SEER range adds $200 more in benefits but costs $315 more in comparison to the

[7] All values related to energy savings, benefits, costs and rebates, provided in the example and Table 1 are from the work paper labeled Cottrell DWP4(CP) provided in Ameren's response to Staff DR JLH 1.02 (Docket No. 13-0498).

15.0-15.9 SEER units. This analysis indicates that the 15.0-15.9 SEER units are economically efficient. That is, there is a greater net benefit to ratepayers from installing 15.0-15.9 SEER ASHPs than there is from installing any other level of energy efficient ASHP.

The table also provides information that indicates that moving from the 15.0-15.9 SEER ASHP to a 16.0 SEER unit as is assumed in the current definition of economic potential, is likely to reduce actual savings to ratepayers as well. The proposed incentive for the 15-15.9 SEER range is $200 but for the 16.0+ SEER range, it is $300. Thus, the program can provide rebates for 50% more 15.0-15.9 SEER ASHPs with the same budget. That is, for every two 16.0+ SEER ASHP rebates provided, the program could incent the purchase of three 15.0-15.9 SEER ASHPs. The work paper from which the data on ASHPs was taken indicates that both ranges of ASHPs have an 18 year life. The 15-15.9 SEER range saves 2017.9 kWh and 0.4 kW annually. The 16.0+ range saves 2093.5 kWh and 0.5 kW annually. Over an 18 year life three 15.0-15.9 SEER ASHPs save 108,966.6 kWH (2017.9 kWh per unit X 3 units X 18 years) and 21.6 kW. Over 18 years, two 16.0+ SEER ASHPs save 75,366 kWh and 18 kW. This indicates that for $600 in incentives (the rebate level for three 15.0-15.9 SEER units or two 16.0+ SEER units) lifetime savings are 33,600 kWh or 44.5% and 3.6 kW or 20% greater with incentives directed towards 15.0-15.9 SEER rated units.

Table 1. An Illustration of Economically Efficient Potential

measure	NPV of Lifetime Incremental Benefits over Baseline	marginal benefit	Incremental Cost per Unit over Baseline	marginal cost	proposed incentive	TRC value
ASHP 14.5-14.9 SEER	669.34	669.34	473.00	473.00	150.00	1.42
ASHP 15.0-15.9 SEER	930.44	261.11	629.00	156.00	200.00	1.48
ASHP 16.0+ SEER	1,130.86	200.42	944.00	315.00	300.00	1.20

Q. Why is the information about economically efficient potential useful for the Potential Studies?

A. The information is useful because it provides information that is not currently available from the definition of economic potential. It provides insight into how much more it costs to move from one level of efficiency to the next and what benefits are gained from doing so. In the example of the air source heat pumps, it revealed that moving to the most efficient cost-effective alternative is probably ineffective. The economically efficient potential analysis showed us that by moving towards incenting 16.0+ SEER ASHPs, the program increases the incentive by $100 (from $200 to $300) and gets an additional per unit first-year savings of 75.6 kWh and .1 kW. Assuming $125 per MW/day (which is PJM's

Reliability Pricing Model value for capacity in 2014), that amounts to paying over $1.26 per additional first-year kWh saved for the last 75.6 kWh.[8]

VI. Conclusion

Q. Does this conclude your direct testimony?

A. Yes, it does.

[8] At $125 per kW/day, an additional .1 kW of savings is worth about $4.56 in the first year ($125/MW/day * 1 MW/1000 kW * 365 days * 0.1 kW greater savings from the 16.0+ SEER units = $4.56). That leaves over $95.44 of the additional $100 in rebates ($300 rebate for 16+ SEER compared to a $200 rebate for 15-15.9 SEER) to pay for energy savings of 75.6 kWh (the difference in energy savings between the 15.0-15.9 and 16.0+ SEER units). $95.44/75.6 kWh = $1.19 per kWh.